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Isolation and characterization of nitrogen-fixing bacteria from compost soil and their impact on nitrogen uptake and plant growth

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Nitrogen-fixing bacteria play a critical role in sustainable agriculture by enhancing soil nitrogen availability, reducing the need for synthetic fertilizers, and promoting plant growth. This study aimed to isolate and characterize nitrogen-fixing bacterial (NFB) strains from compost soil and evaluate their potential to improve nitrogen uptake and plant growth. NFB strains were isolated from compost soil in Karadiyana (6°48' 51.8" N, 79° 54' 17.0" E) using an Ashby medium. The molecular level identification of each isolate was carried out using the 16S rRNA gene region. The production ability of ammonia, nitrate, and nitrite was determined after 7 days of incubation in Ashby broth medium inoculated with each isolated strain. The effect of isolated NFB strains on plant growth was determined using a pot experiment. The isolated nitrogen-fixing bacteria (NFB) strains were introduced to the developed potting media prepared with compost, coir dust, and soil in a 1:1:1 ratio, with mung bean (*Vigna radiata*) selected as the experimental plant. Control potting media was prepared without the inoculation of NFB strains. Shoot length, root length, wet weight, and dry weight of the grown plants were measured after 30 days of the seed germination period as growth parameters to determine the effect of the isolated NFB strains. The molecular level identification confirmed that the isolated strains were *Microbacterium aquimaris* (CTD16), *Bacillus xiamenensis* (MCCC 1A00008), *Bacillus aerophilus* (XA5-12), *Bacillus subtilis* (NCIB 3610), *Bacillus cereus* (CCM 2010), *Bacillus subtilis* (BHU7), and *Bacillus aerius* (24K). The highest ammonia (1.6 ± 0.5 mg/L) and nitrate (1.08 ± 0.04 mg/L) production were recorded in Ashby broth media inoculated with *B. cereus* after 7 days of incubation. Pots inoculated with NFB strains showed a significant increase in measured growth parameters compared to the control ($n = 9$, $p < 0.05$). Potting media inoculated with *B. cereus* strain CCM 2010 showed the best results, with the highest root length (11.3 ± 1.1 cm) and shoot length (17.5 ± 0.5 cm), wet weight (0.6898 ± 0.1 g), and dry weight (0.1015 ± 0.01 g) recorded. The study demonstrated that all isolated *Bacillus* spp. and *Microbacterium aquimaris* exhibited significant roles in nitrogen fixation. These findings indicate their potential as effective biofertilizers, contributing to enhanced nitrogen availability and improved plant health.

Keywords: *Bacillus* spp., Nitrogen fixing bacteria, Plant growth promotion, Sustainable agriculture

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